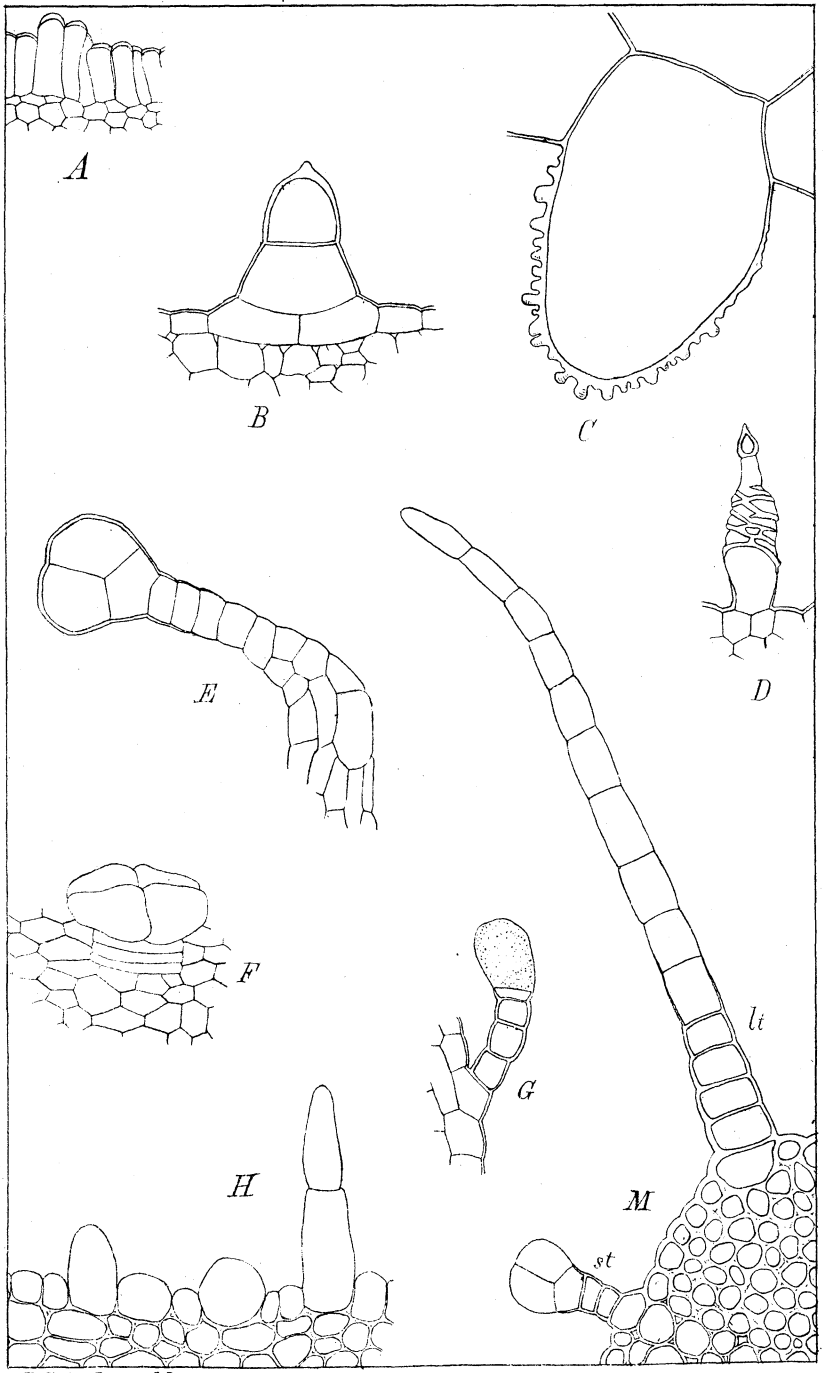

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ARTHUR ON TRICHOMES.

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Various Forms of Trichomes of Echinocystis lobata.—In reexamining recently the results of a study of the anatomy of *Echinocystis lobata*, Torr. & Gr., made some years ago, my attention was attracted to the variety of shapes which its trichomes assume. The diversity is the more unexpected because the plant is "nearly smooth,"* speaking accurately, and what pubescence there is would usually be overlooked.

Of course, the roots near their tips are provided with the well known, delicate, one-celled root-hairs, which are so abundant and long that when a plantlet is pulled from the ground it brings with it quite a weight of soil.

Few hairs are found on the stem except at the growing extremities. In these places they are numerous, and of two shapes—filiform and capitate. Individually they are minute and delicate although forming a slight pubescence when taken as a whole. They are so evanescent as to rarely persist after the growing point of the stem has extended a few centimeters beyond them. The filiform hairs (Pl. I, M, lt) are composed of a single row of terete cells, in which movements of the protoplasm may often be detected under favorable circumstances. They arise from above a hypodermal tissue of collenchyma. The capitate form (Pl. I, M, st) springs from a parenchymatous hypodermal tissue containing chlorophyll. They are much shorter than the first, and consist of a head of two or four large cells side by side supported on a stem of smaller cells. They are more abundant than the filiform ones but less persistent. In general, taking the whole plant into consideration, the filiform ones occur upon projecting portions of the surface, the ridges and edges, which are firm and without stomata: such are the margins of the leaf, the angles of the stem, and the edges of the perianth-cup. There are two exceptions to the rule, for they are also found sparingly both on the flat surfaces of the leaf, and on the exterior of the perianth-cup. The capitate form springs from stomatic surfaces, e. g. channels of the stem, upper and under surfaces of the leaf, exterior of the perianth cup, etc., while within the perianth cup, and on the petals are modified forms (described below) of the same type.

Full grown leaves are minutely scabrous upon both surfaces from the presence of short, thick, and rigid trichomes, which are sometimes tipped with a minute mucro (Pl. I, B).

A very copious supply of delicate glandular hairs (Pl. I, G) upon all sides of the petals gives to them a soft velvety appearance.

*Gray's Manual, 5th ed., p. 186: "nearly glabrous," Fl. North Amer., Torrey & Gray, V. 1, p. 542.

The inner surface of the perianth-cup has numerous flat-heaess-trichomes (Pl. I, F), which have the cells of the short stalk comprded ed vertically like circular plates, and the four or six slightly inflated cells, which at first compose the head, often changed into a head of many cells by formation of vertical, radial partitions. In the closely related *Sicyos*, these flat-headed trichomes are so densely pressed together over the bottom of the cup, that in a cross section it appears at first sight to have a second undulating epidermis supported on short pillars.

Each one of the prickles of the young ovary is tipped with a solitary trichome (Pl. I, E), like the capitate ones of young shoots but much larger, so large in fact that they can be discerned by the unassisted eye. These disappear soon after fertilization, while the prickles continue to grow. The calyx-teeth and the lobes of the very young leaves, which have the same histological structure and appearance as the prickles on the ovary, are not thus equipped.

There are scattered some trichomes of peculiar form among the sort next mentioned. They consist of one comparatively large cell with reticulated thickenings (Pl. I, D), tipped with a small pear-shaped cell. They are straight and rigid but rarely stand upright owing to a weak base.

All the free surface of the connectives, i. e. the surface of the anthers not occupied by the thecæ, both at the apex and sides has the epidermal cells produced into incipient trichomes (Pl. I, A). Their origin and form, and the fact that they are not united laterally, entitle them to this classification. The slight cuticularization of their apices, and total absence of ordinary epidermal cells indicate their near alliance with true epidermis.

A still more curious transitional form is presented in the epidermal tissue of the upper surface of the cotyledonary petioles (Pl. I, H). The epidermis, which is underlaid with a hypoderma of firm collenchyma, presents the anomaly of not being cuticularized. Its cell-walls continue an unequal growth and meeting no outward resistance expand their free surfaces pilosely. The longer cells divide and become several-celled filiform trichomes. In *Cucurbita* the cotyledonary petioles, having the usual cuticularized epidermis, are extremely short, and entirely distinct from each other; *Echinocystis* has the petioles longer and slightly connate; while *Megarrhiza* has very long petioles which are connate throughout, forming a tube. It seems quite reasonable to presume that the upper (inner) surfaces of the cotyledonary petioles of *Megarrhiza* will be found upon examination to be still more strongly pilose by transformation of the epidermis, than those of *Echinocystis*, because of the more perfect protection from environmental influences.

The last example shows a natural transition to trichome-like outgrowths arising from a surface without epidermis. Such were found (Pl. I, C) projecting into the central cavity of the hypocotyledonary stem of an old plant. The wind had twisted the stem so as to rupture it and expose the inside to the weather. Some of the cells of the in

ner surface had expanded, under these changed conditions, into corpulent pseudo trichomes with irregularly thickened walls.

Still more remotely related to true trichomes are the hernioid cells* found in the large vessels of the older roots. They are formed by the local surface growth of a cell-wall lying in contact with a pitted duct, so that the cell-wall, aided by pressure of the cell contents, is forced through the opening of the pit into the cavity of the duct, where it makes a bladder like expansion.

Ovules are in some species of plants considered to be metamorphosed trichomes. But such is evidently not the case in this instance, for the reticulated venation, characteristic of Cucurbitaceous seeds, shows them to be unequivocably homologous with a portion of the leaf-blade.

All the forms mentioned in this article fall under one of two classes, capitate or filiform. Trichomes of the former class are inclined to be glandular while those of the latter are not. This accords well with their distribution over the plant surface. The filiform ones contain the more highly vitalized protoplasm, as manifested by its activity. They are situated on the parts of the plant which are destitute of stomata and growing rapidly, and consequently in need of some other means of directly absorbing water and oxygen from the atmosphere and soil. On the other hand the capitate forms are on surfaces well provided with breathing-pores. The latter serve to absorb oxygen during the earlier stages of growth, while the stomata are inefficient. When the stomata perform their allotted function, and the intercellular spaces are free of sap and protoplasm, these capitate trichomes become glandular and are turned to other service, or disappear.

Considered physiologically, trichomes are not indispensable to the plant, yet in a small way frequently render important assistance. The value of the root hairs is one of the best known facts in Botany, being uniformly illustrated in general treatises, and insisted upon in horticultural essays on transplanting. Hairs on many plants serve for protection against detrimental changes of the weather, the attacks of animals, etc, but in *Echinocystis* the only trichomes that could be considered protective are those which roughen the leaves. Upon rapidly growing parts (especially true, e. g., of young flower buds) the abundance of delicate trichomes aids in supplying oxygen to the tissues. Stomata and air cavities perform this office in the older portions, but in parts newly formed the cavities are filled with protoplasm and cell sap, so as to prevent free circulation of air. Moreover, a very rapid supply of oxygen is required at this time to meet the needs of metastasis by which the increase of protoplasm and the formation and multiplication of cells is effected. The oxygenation of the plant in such growing parts is somewhat analogous to that of some polyps and worms having external filamentous gills, while later it assumes the more efficient internal respiration corresponding to that of insects.

It has already been hinted that there is a similarity of function between the hairs of growing shoots and of young roots. Both subserve

*Illustrations of these are given in Bessey's Botany, p. 30.

the interests of the plant by increasing the surface through which material for the plant's sustenance and growth may be absorbed. The character of such material is determined by the nature of the respective media in which the organs vegetate—of shoots it is gaseous, of roots aqueous.—J. C. ARTHUR, *Univ. of Wis.*

EXPLANATION OF PLATE.—Trichomes of *Echinocystis lobata*, Torr. & Gr.: drawn with camera lucida; uniformly magnified 250 diam.

A. Vertical section of androecium; the epidermal cells transformed into trichomes.

B. Short rigid hair from surface of mature leaf.

C. Cell from interior surface of an injured hypocotyledonary stem; free portion of the cell-wall irregularly thickened; a pseudo-trichome.

D. Reticulated trichome from surface of androecium.

E. Capitate trichome on the point of a prickle of the ovary; inclined to one side, as is common.

F. Flat-headed trichome from interior surface of perianth-cup; seen in perspective.

G. Trichome from surface of petal; its head somewhat glandular.

H. Vertical section of upper part of a cotyledonary petiole; epidermis changing into thin-walled hairs.

M. Transverse section near the apex of a growing stem; *lt* filiform, and *st* capitate trichome.

New Plants of New Mexico and Arizona.—TALINUM HUMILE.—Acaulescent, glabrous and very succulent; root with an oblong orange-colored tuber an inch long; leaves terete, 2–3 inches long, lying flat upon the ground; the dichotomously branched scapes only half as long as the leaves, 5–10 flowered; sepals pointed; petals light yellow, changing to orange in drying; seeds black, marked with circular lines.

On a rocky table land near the southern base of the Pinos Altos Mountains, New Mexico, Aug. 11, 1880. The plant is probably rare, as only some eighteen specimens could be found. The flowers at 2 o'clock p. m. had not yet opened, hence it is one of those species whose flowers open at evening and close in the morning. In habit it is much like *Calandrinia pygmœa*; it has the color and the seeds nearly of *T. aurantiacum*, but is most distinct from that species, by its habit, and its succulent herbage.

LINUM NEO-MEXICANUM.—Annual or biennial, glabrous and glaucescent; stems 1–2½ feet high, branched from the base, the branches very strictly erect and narrowly paniculate for more than half their length; lowest leaves opposite, and when viewed from above showing a cruciate arrangement, the upper alternate, all lanceolate, or oblong, acute, sessile, entire; pedicels 3–6 lines long, with marginal angles; sepals broadly lanceolate, scarcely equalling the capsules, the margins sparingly glandular denticulate; corolla a half inch in diameter, light yellow; styles free to the base; capsule incompletely 10 celled.

In woods of *Pinus ponderosa* on the Pinos Altos Mountains, New Mexico, August and September, 1880. A tall, graceful species, with sometimes almost racemose inflorescence.

BIGELOVIA (APLODISCUS) RUPESTRIS.—Less than a foot high, much branched from the base, woody and brittle; flowering branch